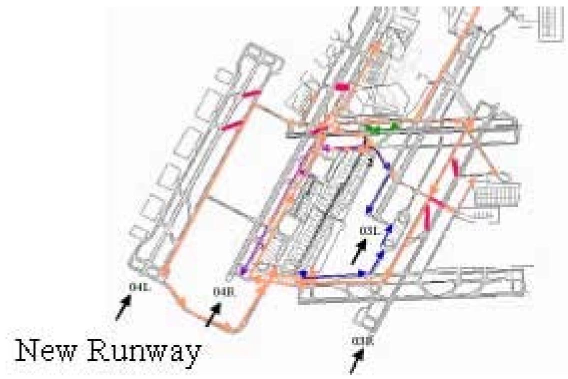
Arrival/Departure Rates

AD-1 Build New Runways

Runway Additions Allow Improved Airport Configurations



Arrival and departure rates at the nation's busiest airports are constrained by the limited number of runways that can be in active use simultaneously. The addition of new runways at 15 airports between now and 2010 will expand airport throughput at the target airport, and possibly for other airports in the same metropolitan area. In most cases the new runways are sufficient to keep pace with forecast demand. But, half of the benchmark airports will not have new runways.

Key Dates

Denver	2003
Miami	2003
Orlando	2003
Houston	2003
Charlotte	2004
Minneapolis	2004

AD-1 Solution Set

Runway additions allow improved airport configurations.

Background

The nation's 31 busiest airports, called large hub airports, account for over two thirds of all passenger enplanements. Much of the delay to air traffic can be traced to inadequate throughput (measured as arrival and departure rates) at these airports. The construction of new runways is the most effective method of increasing throughput.

Ops Change Description

A new runway is included in the OEP when the FAA is reasonably certain of the location, dimensions, timing, and planned use of the runway. Eighteen of the thirty-one large hub airports are at various stages of planning a new runway; 13 of these are included in the OEP. Of the thirteen, one runway (Detroit) became operational in December 2001, seven runways are under construction, two are scheduled to begin construction shortly, two have an environmental impact statement in progress, and one has not yet begun the environmental process. These new runways will improve the throughput for the airport and for national airport system overall.

New Runways and Schedules

Airport	Runway	Environmental Status	Construction To Begin [1]	Runway to Open [1]	Capacity Improvement (Percentage) [2]
Detroit (DTW)	4L/22R	Complete	1999	Open	25% in VFR; 17% in IFR
Denver (DEN)	16R/34L	Complete	2000	2003	18% in VFR; 4% in IFR
Miami (MIA)	8/26	Complete	2001	2003	10% in VFR; 20% in IFR
Orlando (MCO)	17L/35R	Complete	2000	2003	23% in VFR; 34% in IFR
Houston (IAH)	8L/26R	Complete	2001	2003	35% in VFR; 37% in IFR
Charlotte (CLT)	18W/36W	Complete	2002	2004	18% in VFR; 15% in IFR
Minneapolis (MSP)	17/35	Complete	1999	2004	40% in VFR; 29% in IFR
Atlanta (ATL)	10/28	Complete	2001	2005	31% in VFR; 27% in IFR
Boston (BOS)	14/32	Underway	2003	2005	0% in VFR; 0% in IFR
Cincinnati (CVG)	17/35	Underway	2003	2005	26% in VFR; 26% in IFR
Seattle (SEA)	16W/34W	Complete	1998	2006	52% in VFR; 46% in IFR
St. Louis (STL)	12R/30L	Complete	2001	2006	14% in VFR; 84% in IFR
Washington (IAD)	1/19West	Not underway	2005	2007	46% in VFR; 54% in IFR

Scope and Applicability

- A new runway at Boston Logan will reduce delay in certain runway configurations but is not expected to increase the optimum capacity of the airport.

[1] The dates are supplied by the airport sponsor and are contingent on the issuance of a favorable environmental record of decision by the FAA.
[2] The source of the capacity improvement percentage is the Airport Capacity Benchmark Report 2001 (Table 2).

- Five additional large hub airports (LAX, DFW, SFO, BWI, and TPA) are in various stages of planning a new runway or reconfiguring runways, however, the location, dimensions, timing, and planned use of the runway are not certain and are therefore not included in the OEP.

- Runway extensions (i.e., lengthening an existing runway) are not explicitly identified here, but can improve capacity by allowing use by larger aircraft or by eliminating runway intersections.

Key Risks

- Environmental analysis must be completed before a new runway can be built. Runways with big benefits typically have big environmental impacts. Every effort is being made to streamline the environmental review process but it is a long and complicated process.

- Experience has shown that projected opening dates frequently change due to unforeseen circumstances at the local level. FAA (ARP) will monitor schedules and provide updated information on a quarterly basis.

- To realize the benefit of a new runway, the FAA must develop procedures, deploy navigational equipment, and ensure adequate staffing. The OEP provides the coordination mechanism to ensure that these measures are in place when the runway is scheduled to open.

- Pilots may require training/familiarization with new terminal and surface routes and procedures.

AD-1 Responsible Team

Primary Office of Delivery
Paul Galis, ARP-1

Support Offices
ARC-1
ASC-1
ATP-1
ATA-1

AD-1 Links To Architecture

Air Traffic Services / ATC-Separation Assurance / Aircraft to Aircraft Separation Capability
102129 - Current Terminal Separation

Air Traffic Services / TM-Synchronization / Airborne Traffic Synchronization
104109 - Current Arrival/Departure Sequencing

Air Traffic Services / Navigation / Airborne Guidance Capability
107104 - Current Precision Approach

Air Traffic Services / Airspace Management / Airspace Design
108101 - Current Airspace Design

AD-2 Use Crossing Runway Procedures

A means for increasing capacity is to make more use of existing runways. Procedures for use of crossing runways under different conditions, Land and Hold Short Operations (LAHSO), are in use at over 200 airports today. These procedures greatly increase the number of arrivals and departures that can be handled without interfering with intersecting traffic.

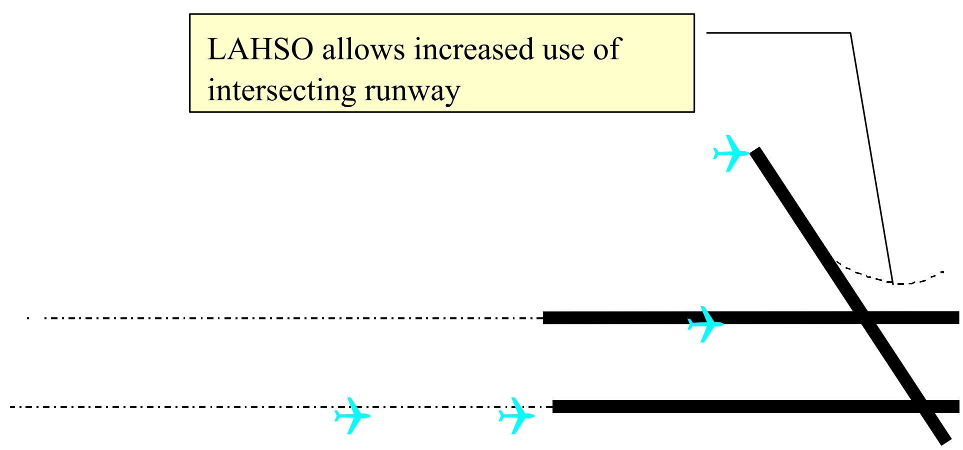
Key Dates:

Safety Assumptions Agreement	2002
Initial Dependent Use of LAHSO	2003
Initial Independent Use of LAHSO	2003

AD-2 Solution Set

Use Crossing Runway Procedures

Land and Hold Short Operations increase use of crossing runways.



Background

Simultaneous Operations on Intersecting Runways (SOIR), either two simultaneous landings or one airplane landing while another was taking off, have been applied under specific waivers to increase airport capacity since 1968. To increase efficiencies for intersecting runway operations, the FAA changed some procedural conditions for conducting SOIR and renamed the program Land and Hold Short Operations (LAHSO). Throughout development of the LAHSO program, users expressed concerns about the safety of conducting LAHSO and associated procedures. In 1997, after the FAA published Order 7110.114, “Land and Hold Short Operations (LAHSO), three major pilot organization, ALPA, APA, and SWAPA launched a vigorous campaign against conducting LAHSO operations as outlined in the order. In April of 1998 the FAA and Industry reached agreement on a number of issues and implemented new procedures for continuance of LAHSO at a number of airports nation wide. The new procedures are based on more critical assumptions and are more restrictive causing significant impact to operations at a number of locations. Pilot organizations were most critical on issues related to safe separation for pilot rejected landings. The FAA, with industry support, attempted to develop and publish "rejected landing procedures" to provide conflict resolution, but test and analysis indicated that the procedures could not guarantee an appropriate level of safety, while conducting independent operations between two intersecting runways. However, data supports a dependent separation procedure that is both safe and offers increased efficiency.

Ops Change Description

LAHSO procedures will improve throughput at airports with intersecting runways. Immediate relief can be provided where dependent operations can be conducted, while analysis of independent procedures continues. LAHSO will be used more widely as more pilots are trained and as compatible procedures are developed for rejected landings and as eligibility criteria are expanded. The expansion will include dependent and independent operations.

Benefits, Performance and Metrics

- LAHSO adds arrival capacity approaching levels for a dependent runway, but will vary with location and airport configuration. It provides up to 10% increase in throughput.

Scope and Applicability

- Changes in LAHSO procedures caused decreased usability, impacting throughput at airports nation wide. Currently, LAHSO is limited to airports where a dependent method of operations exists, or can be identified to support rejected landing procedures.
- Users must collaborate with FAA Air Traffic Procedures to define procedures to make more aircraft types or intersecting runways eligible for LAHSO operations.
- Independent operations using rejected landing procedures are not currently supported based on the safety analysis.
- Extensive analysis is required to prove reasonable assumptions for conducting independent intersecting operations. The study must account for aircraft performance characteristics, wet pavement, general aviation and air carrier mixed operations, and multiple stop locations per runway.

Key Decisions

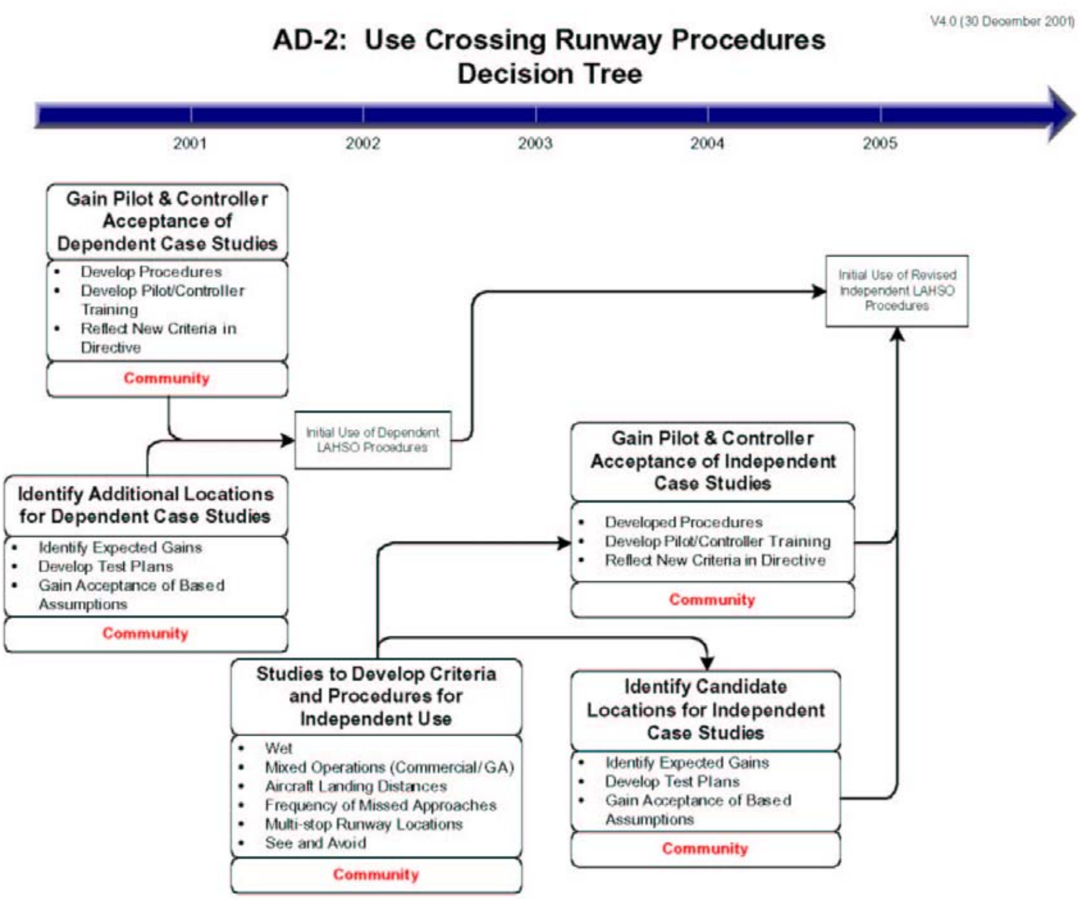
- Concurrence by all stakeholders on safety analysis, approach, and assumptions.
- Established criteria for dependent and independent operations.
- Identification of additional sites for dependent applications and candidates for independent operations.
- Pilot and controller acceptance of roles and responsibilities. The scientific determination of roles and responsibilities through the process of study and analysis needs to involve both

pilots and controllers groups. This involvement allows technical input, addressing human factors issues, from both groups to be use in mitigating workload and other safety issues. Participation will demonstrate first hand the significance of how assigning specific responsibilities are based on safety considerations and the ability to identify appropriate tools for pilot or controller to accomplish any task associate with LAHSO.

Key Risks

- Studies do not validate meeting the operational safety requirements.
- Non-acceptance of roles and responsibilities by controllers or pilots.
- Business Case does not support resources based on other program priorities.

AD-2 Decision Tree



AD-2 Responsible Team

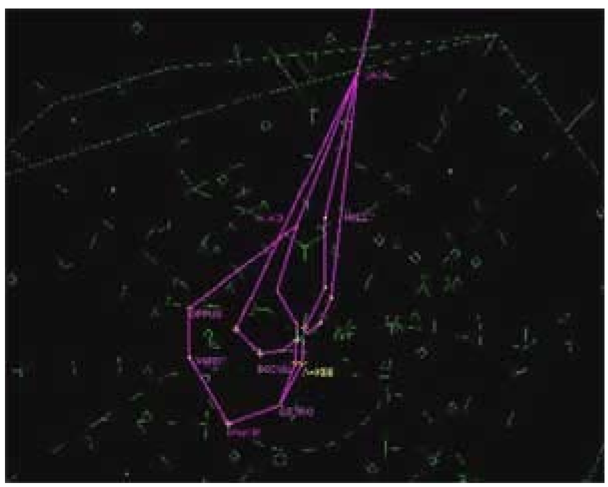
Primary Office of Delivery
Nicholas A. Sabatini, AFS-1

Support Offices
ATP-1
ATB-1

AD-2 Links To Architecture

http://www.nas-architecture.faa.gov/CATSI.cfm?OEP_ID=AD-2

AD-3 Redesign Terminal Airspace and Routes



Designing routes and airspace to reduce conflicts between arrival and departure flows can be as simple as adding extra routes or as comprehensive as a full redesign where multiple airports are jointly optimized. New strategies exist for taking advantage of existing structures to depart aircraft through congested transition airspace. In other cases, area navigation (RNAV) procedures are used to develop new routes that reduce flow complexity by permitting aircraft to fly optimum routes with little controller intervention. These new routes spread the flows across the terminal and transition airspace so aircraft can be separated to optimal lateral distances and altitudes in and around the terminal area. In some cases addition of new routes alone will not be sufficient, and redesign of existing routes and flows are required. Benefits are multiplied when airspace surrounding more than one airport (e.g., in a metropolitan area) can be jointly optimized.

Key Dates

TAAP Evaluation, Overlay RNAV Routes at Seven Congested Airports	2001
Over 100 New and Overlay Routes at Over 20 Congested Airports	2002
San Francisco Terminal Optimization (Dual EDES)	2002
Redesign Phoenix Terminal	2002
Potomac Redesign STAT	2003
Redesign Cincinnati, LA Basin, Northern Cal Terminal	2004
Houston Redesign	2004
Redesign Great Lakes Corridor Terminal	2005
NY/NJ/PHL Metro Airspace Redesign	2006
STL Terminal Redesign	2006

AD-3 Solution Set

Terminal airspace and route redesign.

Background

Current congestion in transition and en route airspace often limits the ability to get departing aircraft off the ground. Similarly, airspace congestion can limit arrivals, even if runway capacity is available. In many terminal areas today, arrival and departure procedures overlap either because they were designed for lower volumes and staffing, or because they are based on ground-based navigation. These routes are strongly interdependent. Many airports have common departure fixes or arrival fixes that must service a variety of aircraft types with different performance characteristics. By requiring departures to navigate or funnel through common departure fixes, the throughput rates at the airports involved must be suppressed. Similar problems exist with arrivals.

Ops Change Description

The operational change described here includes three concepts to reduce interdependencies between arrival and departure flows:

- AD-3.1: Use existing airspace structures and apply traffic management strategies to depart aircraft through congested transition airspace. Capping and tunneling techniques are included as part of the National Airspace Redesign System Choke Points program.
- AD-3.2: Restructure arrival and departure routes to be independent of navigation aids, using existing RNAV technologies RNAV route development is a primary function of Air Traffic procedural development and a foundation element of the National Airspace Redesign.
- AD-3.3: Optimization and redesign of the terminal area airspace and operations. Terminal optimization and redesign projects are a key component of the National Airspace Redesign.

Terminal airspace optimization and redesign is a foundation component of the National Airspace redesign. Terminal airspace optimization efforts are ongoing initiatives to ensure the airspace design and use is effective for transitioning aircraft to and from the associated airport or airports.

Terminal airspace redesign is a major undertaking to develop a structure that takes full advantage of evolving technologies and aircraft capabilities. This redesign will provide flexibility for system users to efficiently transition into and out of terminal airspace while making maximum use of airspace and airport capacity.

Where volume has increased and the current airspace structure is the limiting factor, redesigning these procedures, including the addition of RNAV procedures, will allow for more efficient use of the constrained terminal airspace. Area Navigation, or RNAV, is a method of navigation that permits aircraft operations on any desired course within the coverage of station referenced navigation signals or within the limits of self contained system capability or combination of these. The acronym "RNAV" has been adopted by industry as an umbrella term that encompasses any procedure or operation that utilizes point to point navigation, from ground or air-based/space-based sources. The expectation is that in the future, this will evolve away from dependence on ground-based navigation resources. This is manifested through use of on-board avionics and flight management systems (FMS).

RNAV procedures in terminal airspace can reduce complexity and increase efficiency in the near and mid-term. When designed collaboratively, the procedures require minimal vectoring and/or communications between the flight crews and the ATC controllers. These procedures can be used to reduce voice communications associated with speed and altitude instructions, freeing up more controller time. The procedure, when implemented, describes a flight path that includes position, altitude, and time.

Benefits, Performance and Metrics

- Increase on-time departures.
- Increase airport capacity utilization effectiveness.
- Improved predictability

A procedure is predictable if the time to fly the procedure and the distance flown each time the procedure is executed is close to the same. Some ARTS track data for the CLT NALEY departure procedure from Sept 8 and 9, 2000 was used to compute average flying times and distances and their dispersions. This data set provided 14 flights that flew the departure procedure and during this same period there were 37 flights that did not fly the procedure. These flights were aircraft departing to the same departure fix as for NALEY, so it was appropriate to compare the flying times and distances of these flights with the RNAV flights. CLT facility had identified which aircraft were equipped and flew the procedure. Table AD-3.1 summarizes the results of flying times and distances for this set of aircraft. For this data set, the average flying time and distance was the same for the RNAV and non-RNAV aircraft. However, the dispersion in the flying times and distances differed. The dispersion in the flying times on the non-RNAV aircraft was 3 times larger than for the RNAV and the dispersion in the flying distances was over twice as large as for the RNAV.

Table AD-3.1 CLT NALEY Departures

Sept. 7 and 8	RNAV Flights (14)	Non-RNAV Flights (37)
Average Flying Time (min)	6.6	6.6
Standard Deviation (min)	.1	.3
Average Flying Distance (nm)	31.4	31.4
Standard Deviation (nm)	.4	.9

  - Reduced excess gate times (duration and/or occurrence).
  - Reduction in en route delay.
- Arrival rates percent effectiveness increase for airports where the en route transition sectors suffer high frequency congestion (e.g., ATL northeast arrivals).
- Allows controller to deliver the aircraft with reduced restrictions and vectoring.
- Workload reductions so controllers can reduce restrictions to aircraft and close up spacing to the separation standard.
- Assuming that the use of RNAV is the primary flight practice for arrivals, the percent of control transmissions can be reduced per day by the estimates[3] in the following tables. The reduction in number of air/ground communications will reduce controller and pilot workload, as well as mitigating the advent of frequency congestion issues in the future. Overall effect is to maintain maximum utilization of available runway capacity.

Table AD-3.2 Percent Reduction In Control Transmissions

Airport	Percent	Airport	Percent	Airport	Percent	Airport	Percent	Airport	Percent
BOS	29	ATL	32	DFW	33	LAX	27	MSP	23
EWR	38	MIA	28	STL	17	PHX	33	OAK	19
ORD	42	PHL	37	LAS	37	DEN	37	DTW	20

Following September 11, ETMS flight plan data was used to compute the percent RNAV equipage at the top 25 airports by operations. The before timeframe data consisted of 8/11/01-9/6/01 and the after timeframe data consisted of 10/12/01-11/18/01. The 30 days following 9/11/01 were considered a transition period and were excluded from the analysis. It is reasonable to assume that the before RNAV equipage levels matched the levels used to produce the numbers in Table AD-3.3 above. Table AD-3.4 summarizes the percent change in RNAV equipage for these 25 airports. Note that the airports are not ordered by number of operations in the table.

Table AD-3.3 Percent Change in RNAV Equipage Post-September 11, 2001

[3] Estimates are generated based on real world experience of actual transmission reductions at several current locations. Estimates are based on levels of equipage and estimates of transmissions per flight in the terminal area at these locations, based on data available pre-September 11. Estimates are for airport specific populations. Revalidation of these estimates is currently underway.

Arrival/Departure Rates OEP Version 4.0 (6 December 2001)

Airport	Percent Change	Airport	Percent Change	Airport	Percent Change	Airport	Percent Change	Airport	Percent Change
BOS	+8	ATL	+3	DFW	0	LAX	0	MSP	+4
EWR	+4	MIA	+6	STL	+5	PHX	0	OAK	0
ORD	+5	PHL	+3	LAS	-2	DEN	+4	DTW	+5
CVG	+6	PIT	+8	IAD	+2	CLT	+2	SEA	+1
SFO	-1	SNA	-2	SBF	0	IAH	+8	MEM	+4

This table illustrates that the average RNAV equipage at these airports has increased approximately 3%. These changes in were used to update TableAD-3.3 and are given in Table AD-3.4 below:

Table AD-3.4 Percent Reduction In Control Transmissions Post-September 11, 2001

Airport	Percent	Airport	Percent	Airport	Percent	Airport	Percent	Airport	Percent
BOS	36	ATL	35	DFW	33	LAX	27	MSP	28
EWR	39	MIA	31	STL	22	PHX	33	OAK	19
ORD	46	PHL	39	LAS	33	DEN	40	DTW	24

AD-3.1 Expedited Departure Routes

Scope and Applicability

Two traffic management techniques are being used in the near- and mid-term to expedite departures into congested transition airspace:

- LAADR (Low Altitude Alternate Departure Routes) is a program that allows aircraft to take off, climb to a lower altitude and then achieve their desired/requested altitude later in the flight. Aircraft can proceed to desired altitude as soon as controller clears them. A Letter of Agreement (LOA) is needed between participating facilities along with agreements from participating airlines. This program is facilitated by the ATCSCC. Two LAADR Memoranda of Understanding (MOUs) exist: STL and PHL.
- As part of National Airspace Redesign Choke Points activities, TAAP (Tactical Altitude Assignment Program) is being explored as a viable method to get traffic operating in less congested altitudes, though perhaps these altitudes are less optimal in terms of fuel usage. TAAP is expected to reduce en route congestion and has potential benefits of getting aircraft off the ground sooner, although filing TAAP does not guarantee that the flight will depart sooner. TAAP is voluntary for airline participants (they must file TAAP routes) and involves flying at lower altitudes for shorter length flights. Flights that operate under TAAP are expected to fly at the lower altitudes for the whole length of the flight, and neither the pilot nor controller is supposed to climb the aircraft for efficiency purposes. Routes, between over

100 city pairs, within eight ARTCCs in the Great Lakes corridor, Northeast, and Mid-Atlantic have been identified and agreed upon for TAAP.

Key Decisions

- None identified.

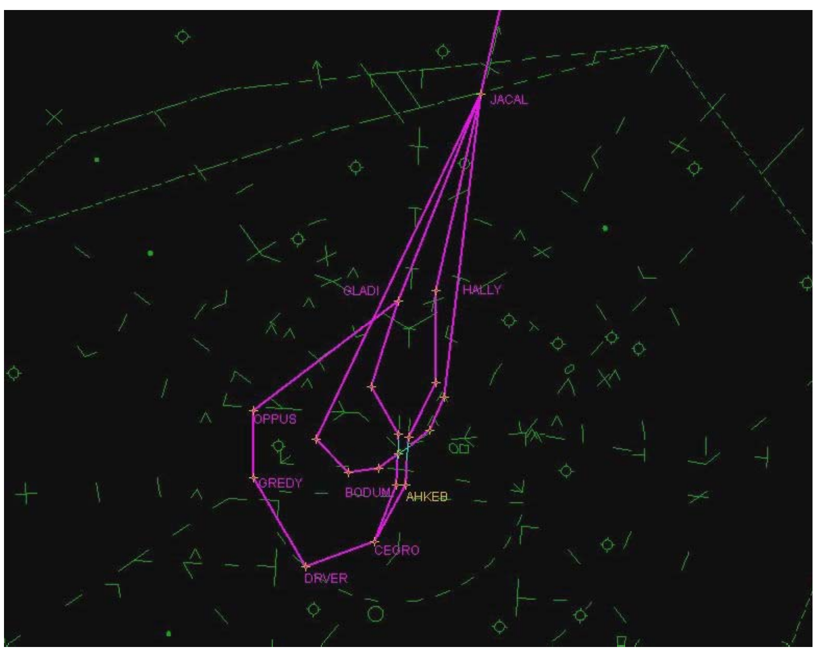
Key Risks

- None identified.

Status of Key Milestones

- TAAP and LAADR efforts are complete. The TAAP evaluation (flights between 300 city pairs at lower altitudes and out of busy high altitude sectors) was initiated on April 22, 2001 and completed on June 20, 2001. The results of the evaluation concluded that TAAP as a national initiative would not be as effective as planned. In place of TAAP, Low Altitude Initiatives (using the same principles of TAAP) have been implemented on a local facility level. LAADR continues to be used when applicable at sites with MOUs.

AD-3.2 Routes Independent from Navigation Aids



Scope and Applicability

RNAV allows for the creation of arrival and departure routes (specifically, allowing multiple entry to existing and STAR and multiple exits from Departure Procedures (DPs)) that are independent of present fixes and navigation aids. Airports with complex, multiple runway systems, or with shared or congested departure fixes benefit the most through segregating departures and providing additional routings to reduce in-trail separation increases during climb. Participation and benefits are subject to aircraft equipage levels, pilot/controller education. Radar is required for RNAV operations below FL450 (order 7110.65 5-5-1).

Design, evaluation and implementation of RNAV arrival and departure routes is ongoing across the United States. Current implementation plans include:

- In the near-term, overlay RNAV routes are being developed at EWR, PHL, JFK, CLT, IAH, LAS, and PHX.
- For the mid-term (through FY04), over 100 overlay and non-overlay routes are planned for these and additional sites, including all of the 31 benchmarked airports (STL, EWR, IAD, JFK, PHL, DCA, BWI, LGA, PIT, CVG, DTW, ORD, MSP, BOS, DEN, SEA, SLC, ATL, CLT, MCO, MEM, MIA, TPA, DFW, IAH, LAS, LAX, SFO, SNA, HNL, PHX).
- In the longer-term, RNAV with speed control will be used to support minimal spacing of aircraft on arrival. The controller maintains constant minimum spacing only between back-to-back pairs of RNAV arrivals (both must be equipped to tighten up spacing) through clearances for altitude and speed control procedures. RNAV arrival routes will not change requirements for final approach.

Key Decisions

- Identify and ensure user equipage to deliver desired benefits.
- Manufacturers and users must complete avionics certification for FMC – Required Navigational Performance (RNP), ARINC 424 (for new types).
- Pilot and controller training must be completed. Flight Crew Education includes FMC proficiency, phraseology, and ATC procedures.

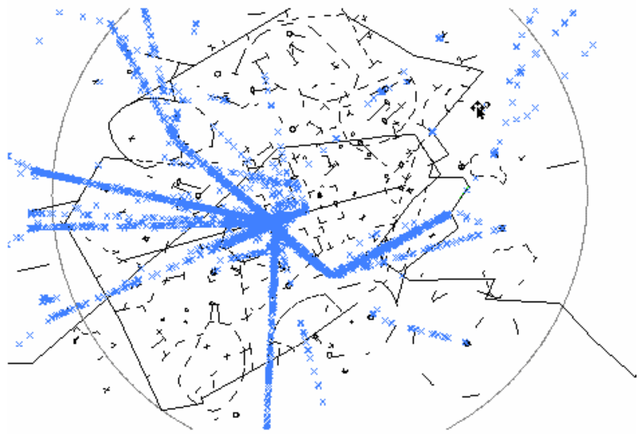
Key Risks

- Environmental assessment for new routes and procedures. The implementation timeframe for these projects could increase significantly depending on the level of environmental assessment required by the proposed change.
- Segregated routes based on equipage may penalize non-equipped users. Rulemaking may be required. AOPA has indicated possible acceptance of RNAV equipage being necessary to access major congested airports during specific, limited times of day, but they must maintain access to key GA airports (e.g., Teterboro) located in close proximity to potential RNAV mandated airports.
    - Systems that must be in place or may cause risks in delivery include Flight Management Computers (FMC), ATC Host/ARTS automation adaptation and display of RNAV status, and STARS adaptation and display of RNAV status.

Status of Key Milestones

- Over two dozen RNAV procedures (STARs, DPs) have been implemented at sites including BOS, CLT, DFW, EWR, IAD, IAH, JFK, LAS, PHL, PHX, and SEA.
- The number of revenue flights at PHL, EWR, JFK, and CLT is over 72,400 as of 12/01.

AD-3.3 Redesign Terminal Airspace



Improved Terminal Airspace Structure

Scope and Applicability

Terminal airspace optimization (mid-term) and redesign (long-term) projects are ongoing across the United States. Efforts are planned for all major metropolitan areas and congested terminal areas servicing key airports. These include:

- Mid- and long-term, large-scale redesign efforts are underway in Anchorage, St. Louis, Omaha, New York, Philadelphia, Potomac, Cleveland, Minneapolis, Detroit, Chicago, Bradley, Seattle, Portland, Denver, Cincinnati, Orlando, Charlotte, Houston, Santa Barbara, San Diego, Phoenix, Los Angeles, Las Vegas, Honolulu, and San Francisco. These redesign projects include expansion of terminal airspace (see AD-5), RNAV-base routes (see AD-3.2), arrival and departure corridors, and expanded use of terminal holding. Establishment of arrival reservoirs in the terminal airspace will allow for maximum use of runway capacity.

  - Implementation for NY/NJ/PHL Redesign is planned for 2005/2006 and Potomac is planned for 2003. Alternative designs for NY/NJ/PHL and Potomac include optimization using existing infrastructure (tweaking of the current system) and redesign from a "clean-sheet." Redesigned arrival and departure routes will likely be defined as RNAV-based, not dependent on current ground aids. Design concepts include high downwind segments for arrival aircraft, unrestricted departure climbs, fanned departure headings, and VFR flyway corridors. As part of the Choke Points Action Plan, the Yardley-Robbinsville Flip-flop will provide efficiency improvements in the near term. This effort, scheduled for implementation in December 2001, will add four terminal sectors and adjust flows into the New York metropolitan area from the south.

Key Decisions

- None identified.

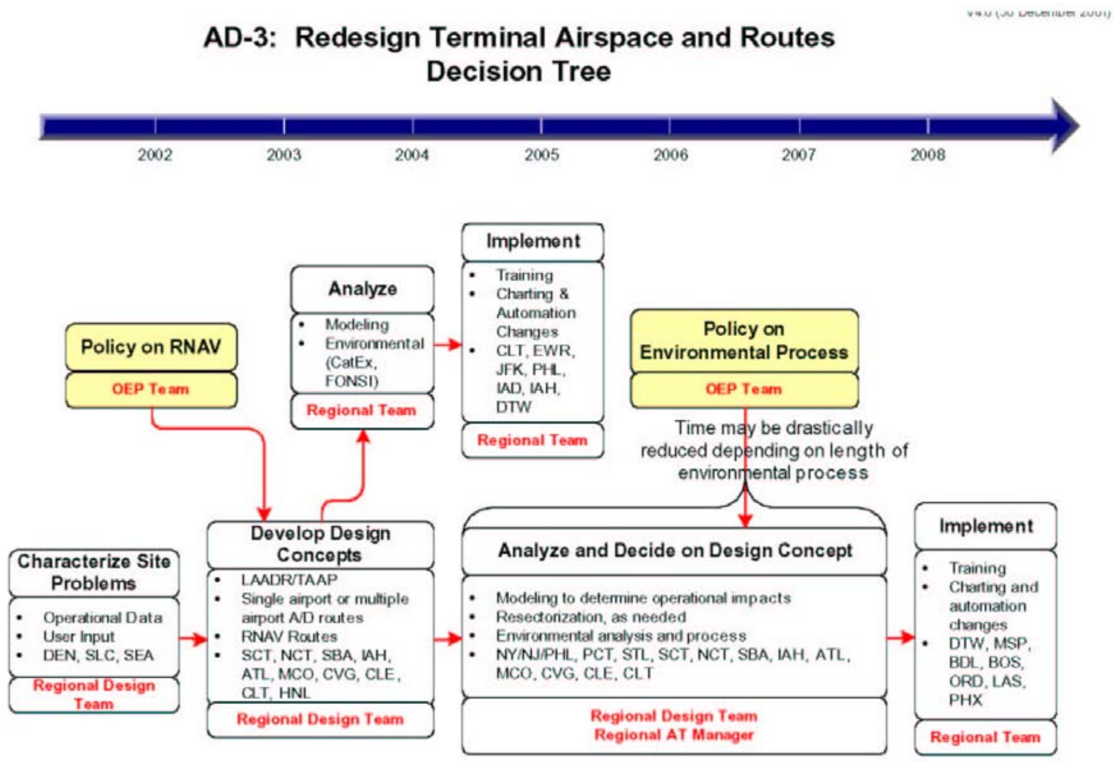
Key Risks

- Several infrastructure adjustments will be needed to support new sectors, including availability of building space, ATC automation, controller position equipment, and additional frequencies. Lack of availability of these systems may negatively impact the ability to transition to new sectorization or to implement additional sectors. Limitations of the current systems, specifically the HOST computer, will limit potential efficiency of some of the proposed airspace changes.
- Environmental assessment for new routes and adjusted traffic flows. The implementation timeframe for these projects could increase significantly depending on the level of environmental assessment required by the proposed change.

Status of Key Milestones

- LAS Four Corner Post Airspace Redesign was implemented in late 2001. The PHX Northwest 2000 Redesign is awaiting completion of the environmental process (, thus delaying implementation until 2002.

AD-3 Decision Tree



AD-3 Responsible Team

Primary Office of Delivery
Sabra Kauhia , ATA-1

Support Offices
Regional Air Traffic Managers
Regional Airspace and Operations Managers
Regional Airspace Focus Leadership Teams
Facility Airspace Design Teams
ATP-1
ATT-1
AFS-400
AVN-1
AIR-100

AD-3 Links To Architecture

Air Traffic Services / TM-Strategic Flow / Flight Day Management
105204 - Collaborative Rerouting (CRCT Demonstration)

Air Traffic Services / Airspace Management / Airspace Design
108101 - Current Airspace Design
108102 - Flight Management System Departure Procedure
108103 - Expanded RNAV Departure Procedures

AD-4 Fill Gaps in Arrival and Departure Streams

Automated decision support tools provide controllers more information on airport arrival demand and available capacity for making decisions on aircraft spacing. Improved sequencing plans and optimal runway balancing increase arrival and departure rates as much as ten percent. Free Flight tools will help air traffic controllers balance runway use and sequence aircraft according to user preferences and airport capacity.

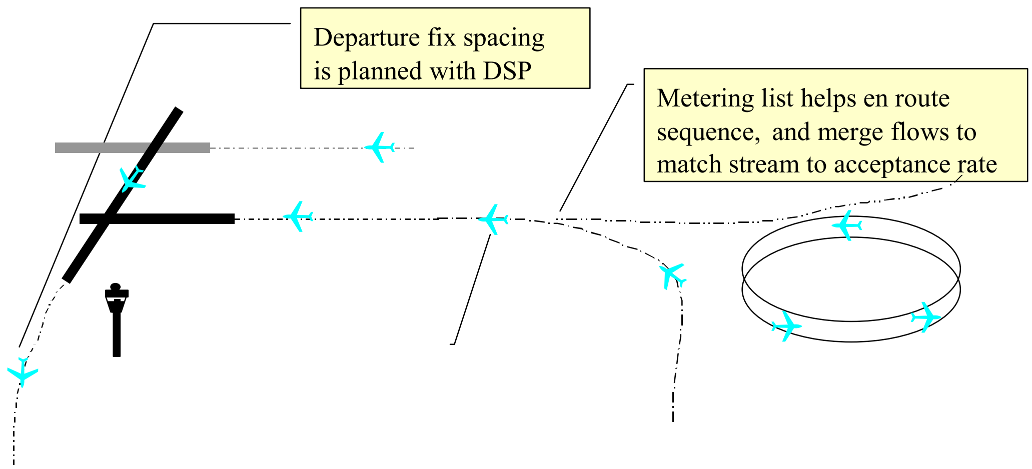
Key Dates

Single Center TMA at ZFW, ZLA, ZMP, ZOA, ZTL	2001
DSP at Boston, Washington	2002
Validate TMA Multi-center	2003
Further Single Center TMA Deployment	2004

AD-4 Solution Set

AD-4: Fill Gaps in Arrival and Departure Streams

Improved planning information through use of decision support tools.



Background

During periods of high traffic demand, realizing the full potential throughput at an airport requires the controller to space aircraft at the minimum required for safety. At most locations, controllers rely on experience and their ability to extrapolate the future position of aircraft to develop spacing plans and to execute these plans. Research on automated decision support tools has shown that controllers can improve their planning, which results in improved throughput.

Ops Change Description

Controllers and TMCs will have improved information on arrival and departure demand and on available capacity. Decision support tools will assist them in developing improved sequencing. These plans will reflect an improved ability to project the future position of the aircraft, to optimize use of runways and fixes, and to account for separation requirements based on aircraft weight classification. The result will be an improved balancing of the airport runway assets and an increase in the airport throughput rate for both arrivals and departures. In addition, the execution of the plan will be improved through the provision of tools that show controllers the delay required for each aircraft. Arrival metering will transition from being mileage based to being time based.

- <u>AD-4.1:</u> *Departure Spacing*—The Departure Spacing Program (DSP) will improve the sequencing of aircraft from multiple airports over common departure fixes and will reduce departure delays. DSP will also provide a means to apportion departure delays among participating facilities and flights, based on determinations made by TMCs of the most advantageous TFM operational scenario for the predicted traffic and weather conditions. Initial DSP capabilities are already available for New York airports.

- AD-4.2: *Metering and Merge Planning*—Traffic Management Advisor – Single Center (TMA-SC) will provide a metering plan to TMCs and provide information to controllers to quantify the differences between assigned meter times and the times that aircraft are projected to cross a meter fix. A planned enhancement to TMA, Traffic Management Advisor – Multi Center (TMA-MC) will support metering at airports that are near multiple center boundaries or where the arrival flows may interact with the flows to other airports.

Benefits, Performance and Metrics

- DSP will reduce the coordination time necessary for departures in complex airspace and during severe weather situations, and will result in reduced departure delays.
- Due to improved information from TMA to TMC's and controllers, arrival rates will increase 5 percent. Estimated improvements are based on results from implementation at Free Flight Phase 1 sites.

AD-4.1 Departure Spacing

DSP will provide Tower, TRACON, and Center controllers and TMCs with information on departures. This information will include routes, aircraft status, and departure timeframes.

Scope and Applicability

- DSP will improve the sequencing of aircraft from multiple airports over common departure fixes and will reduce departure delays.
- DSP will initially focus on New York/New Jersey airports (including PHL), then on Boston and Washington area airports in FY 02. DSP will be applicable in the Northeast corridor of the United States, where multiple airports share oversubscribed departure fixes and routes.
- In parallel, the NASA will be developing a controller decision support tool for expedite departure path planning (EDP) to assist the controller in precisely meeting DSP flow rates over departure fixes and, where possible, to merge departures directly into en route streams.

Key Decisions

- None identified.

Key Risks

- None identified.

AD-4.2 Metering and Merge Planning

Decision support tools provide the TMC with a metering plan and the controller with information on the required delays for each aircraft (also see ER-7.2).

Scope and Applicability

  - TMA (Traffic Management Advisor) is applicable for airports where arrival demand regularly exceeds capacity.
  - TMA-SC (Traffic Management Advisor – Single Center) near-term and mid-term locations include: ZFW-DFW (complete), ZMP-MSP (complete), ZDV-DEN (complete), ZMA-MIA (complete), ZOA –SFO (complete), ZLA-LAX (complete), and ZTL-ATL (complete).
  - Additional arrival sites will require site specific adaptation. FFP2 plans to deploy TMA-SC to support arrivals at the following airports: ZME-MEM, ZKC-STL, ZID-CVG, and ZHU-IAH. Deployment order and schedule have not been finalized, but the current plan is to deploy to 1 site in FY 03, 2 sites in FY04, and 1 site in FY 05. Expansion to additional sites may include supporting arrivals to MCO, CLT, SEA, SLC, PHX, BOS, and LAS.
- TMA-MC (Traffic Management Advisor –Multi Center) will enhance TMA to work in areas where the airport is close to the center boundaries and where arrival flows interact with flows to other airports. RTCA recommended TMA for several sites that require TMA-MC capability, these include Washington area airports, N90 airports, PHL, DTW, SDF, BOS, and PIT. NASA is developing TMA-MC with emphasis on PHL airspace; this capability should be ready for evaluation in FY 03.
- In parallel, research is also ongoing as part of the Safe Flight 21 program to develop an application that enables more optimal spacing by providing pilots with advisories on airspeeds needed on final approach to maintain spacing objectives and increase efficiency.

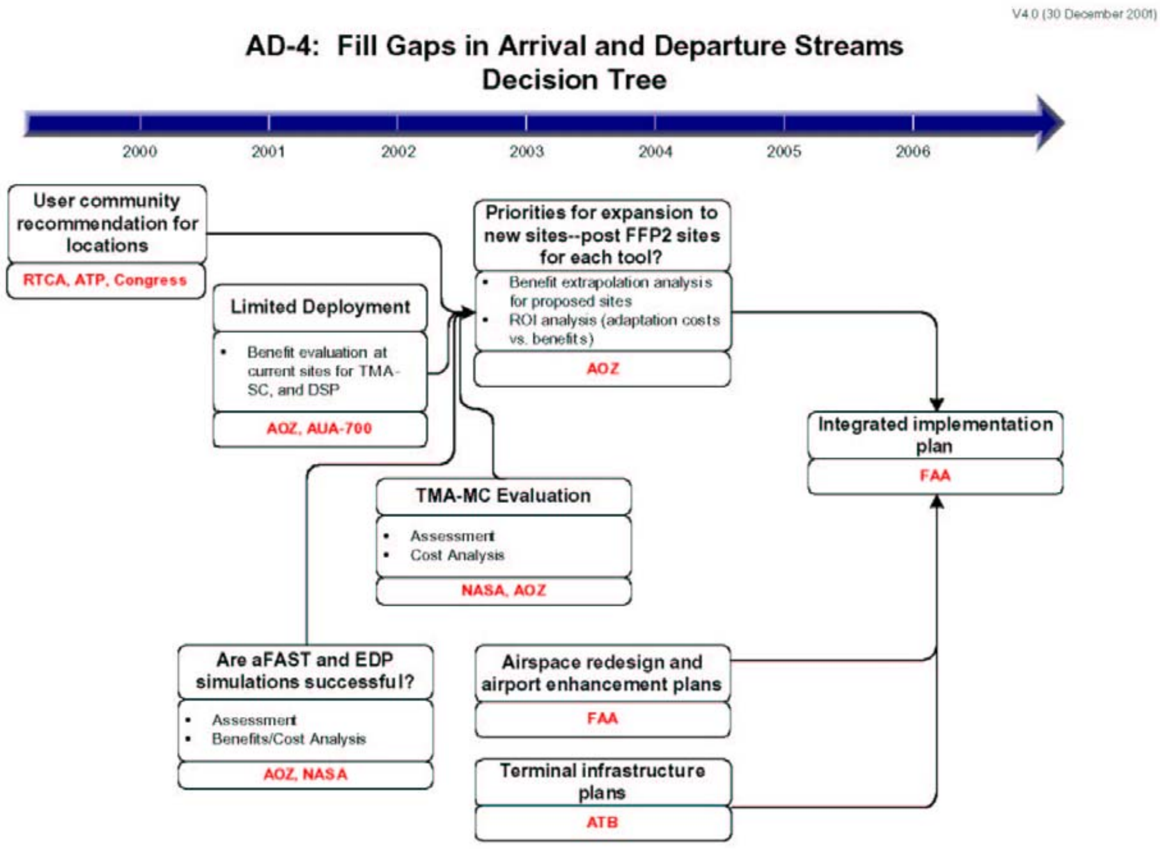
Key Decisions

- Priorities for TMA deployments beyond the current recommendations.

Key Risks

  - NASA is currently researching TMA-MC. Implementation is dependent on the success of this research and on NASA participation in technology transition.
- New York and Philadelphia redesign activities will result in changes to TMA adaptation and therefore work in these areas needs to be coordinated.

AD-4 Decision Tree



AD-4 Responsible Team

Primary Office of Delivery
John Thornta, AOZ-1
Support Offices
ATP-1
ATB-1
AUA-700

Working Forums
RTCA

Other Websites
RTCA
Free Flight Program Office

AD-4 Links To Architecture

Air Traffic Services / TM-Synchronization / Airborne Traffic Synchronization
104109 - Current Arrival/Departure Sequencing
104116 - Traffic Management Advisor - Single Center (FFP1)
104117 - National Traffic Management Advisor - Single Center
104118 - Traffic Management Advisor - Multi-Center (NASA Demo)
104119 - National Traffic Management Advisor - Multi-Center

AD-5 Expand Use of 3-Mile Separation Standard

Potomac Consolidated TRACON

Current aircraft separation standards allow for 3-mile separation when within 40 miles of a single radar sensor. By identifying opportunities to maximize the use of the 3-mile separation, additional airspace efficiency can be achieved. One effect would be more optimal control of aircraft during transition to and from the airport. Methods to maximize use of the 3-mile separation include: expansion of terminal procedures to surrounding en route airspace at selected single airports, encompassing multiple airports in a single facility with redesigned airspace, and the consolidation of terminal radar approach control facilities (TRACONs). Care must be taken to ensure general aviation access to this airspace is not unduly impaired.

Key Dates

Santa Barbara Expansion	2002
Potomac Redesign & consolidated TRACON	2003
Boston Consolidated TRACON	2004
Redesign Cincinnati, LA Basin, Northern California Terminal	2004
Houston Redesign	2004
NY/NJ/PHL Metro Airspace Redesign	2006
Charlotte Redesign	2006

AD-5 Solution Set

AD-5: Expand Use of 3-Mile Separation Standard

Expand use of 3-mile separation standards and terminal separation procedures.

Background

Current separation standards allow for 3-mile separation when within 40-miles of a single radar sensor. By identifying opportunities to maximize the use of the 3-mile separation standard, additional airspace efficiency may be achieved. This would afford more efficient control of aircraft during transition to and from the airport.

Ops Change Description

Currently, expansion of designated terminal airspace is the only planned opportunity to gain this type of efficiency. Other methods of improving surveillance, such as improved radar update rates or other forms of advanced surveillance, may offer options to expand usage of 3-mile standards or reduce separation standards in transition airspace in the future. In particular, deriving equivalent position accuracy as that within 40 miles of a radar may be achievable through evolving technologies like ADS-B and/or improved surveillance data processing.

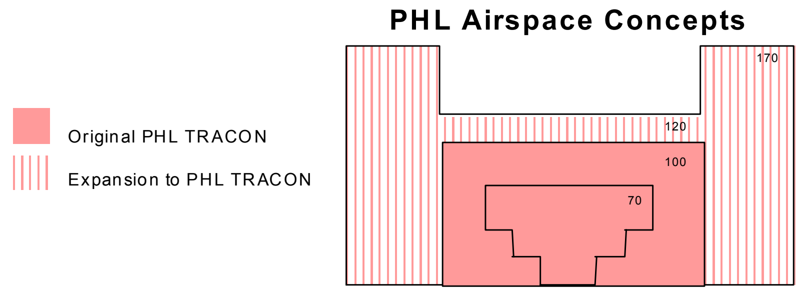
Three methods of expanding designated terminal airspace are described here:

- AD-5.1: Expansion of terminal procedures application by reassigning en route airspace to terminal facilities (does not require consolidation of facilities).
- AD-5.2: "Terminalization of the airspace" through consolidation of terminal and en route operations for airspace servicing the New York metropolitan area.
- AD-5.3: Consolidation of terminal airspace with acquisition of en route airspace.

Benefit, Performance and Metrics

- Increase in percent effectiveness for top airports
- Increase in on time departure rate
- Decrease in excess taxi times
- Decrease in ground delay programs

AD-5.1 Expansion of Terminal Procedure Applications



Scope and Applicability

- Terminal redesign projects in several areas are considering reassigning airspace currently controlled by en route facilities and releasing airspace responsibility to adjoining terminal control facilities to reduce separation, coordination, intermediate level-offs, and other TRACON to center handoff restrictions.
  - The applicability of this approach (where en route airspace can be reassigned to terminal control) is dependent on available infrastructure (communications, navigational aids, surveillance coverage, automation upgrades, and facilities) and ability of the workforce to accept additional traffic.
  - Current projects include expansion of terminal airspace at Philadelphia, Santa Barbara (Central California), Phoenix, Cincinnati, Seattle, Charlotte, Southern California, Northern California, and Chicago.

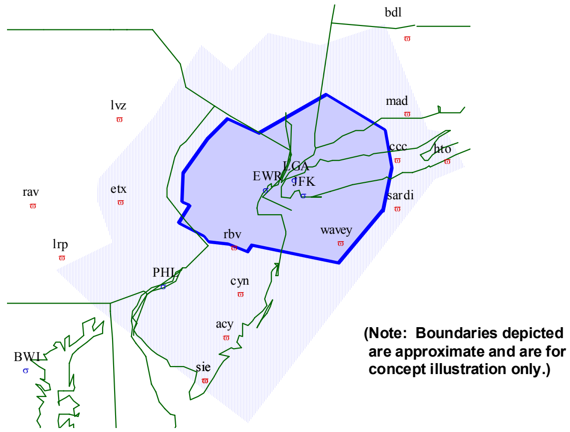
Key Decisions

- None identified.

Key Risks

- Environmental impact assessment may be required. The implementation timeframe for these projects could increase significantly depending on the level of environmental assessment required by the proposed change.

AD-5.2 Single Facility for En Route and Terminal Operations in New York



Scope and Applicability

- The FAA is in the early planning stages of airspace design and control changes surrounding the airspace supporting the New York metropolitan area. This concept involves "terminalization" of the en route airspace controlled by the en route facilities abutting the New York TRACON. "Terminalization" of the airspace will allow for reduced separation and better coordination resulting in greater efficiency in airspace management around New York.
- Effected control facilities include ZNY, ZBW, ZDC in en route airspace; N90, PHL TRACON in terminal airspace.
- Affected major airports: LGA, JFK, EWR, PHL.
  - Also affects flows into and out of ZOB and may affect flows to Boston.

Key Decisions

- FAA should determine if a single facility will be pursued.

Key Risks

- Significant environmental analysis will need to be completed. The current NY/NJ/PHL redesign includes environmental analysis to support new airspace and procedures, but does not include environmental analysis for a new building. Environmental impact assessment for a new building will be needed and has not been included in current environmental plans for NY/NJ/PHL Redesign.
- Determine affordability of proposed consolidation of operations. Cost-benefit assessment of the single-facility concept must be completed, and a decision must be made as to how to proceed with the building portion of the concept.
- Several infrastructure changes will be required to implement this concept. Current plans have identified these needed changes and teams are being formed to conduct necessary analysis. Issues being examined by AEA include:

- Rerouting communications and radar data to the consolidated facility or (for high altitude airspace) to the Boston and Washington ARTCCs.
- Providing the kind of radar coverage that would permit use of three-mile separation throughout the airspace in question, including the surveillance data processing that would be required.
- Providing flight data processing for the consolidated facility.
- Creating the necessary infrastructure (e.g., power supply, cooling) associated with the building in which a consolidated facility would reside.

- Security and contingency planning issues must be identified and resolved.

AD-5.3 TRACON Consolidation

Potomac Consolidated TRACON

Scope and Applicability

- TRACON consolidation involves merging separate terminal radar approach controls into a single, consistent operation housed in one building. For example, the Potomac Consolidated TRACON will include the consolidation of Baltimore, Andrews, National, and Dulles TRACONs. TRACON consolidation includes airspace redesign, procedures definition and building a common facility.
- Terminal airspace and facility consolidation/new building projects include: Potomac Consolidated TRACON (2003), Boston Consolidated TRACON (2004), Atlanta continued consolidation (2005), and Houston (in design, awaiting JRC).Houston is not a TRACON consolidation project in the pure sense, but is dependent on a new building to accommodate proposed operational and airspace changes.

Key Decisions

- None identified.

Key Risks

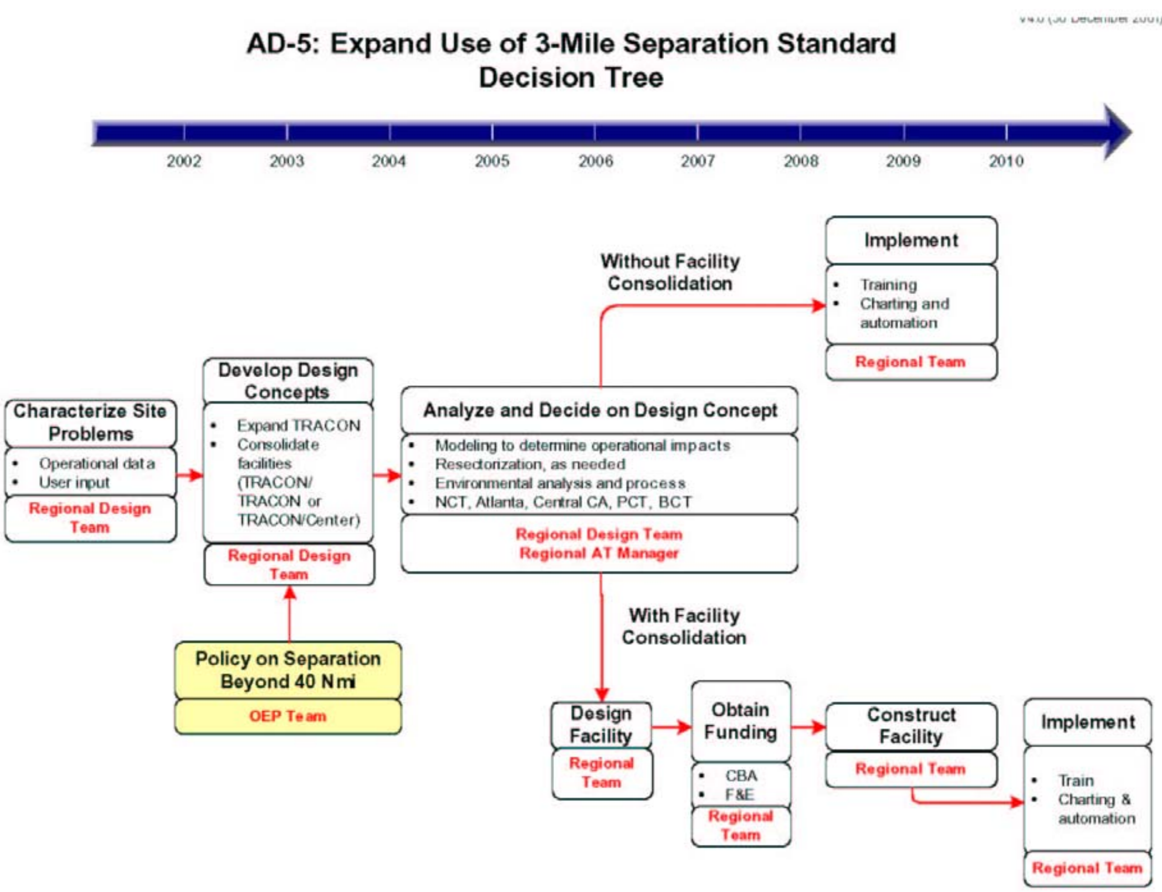
- Several infrastructure changes will be required to implement facility consolidation:

– Rerouting communications and radar data to the consolidated facility.

– Providing flight data processing for the consolidated facility.

- Creating the necessary infrastructure (e.g., power supply, cooling) associated with the building in which a consolidated facility would reside.
- NATCA has stated that they do not support additional TRACON consolidation.
- Security and contingency planning issues must be identified and resolved.

AD-5 Decision Tree



AD-5 Responsible Team

Primary Office of Delivery
Sabra Kaullia, ATA-1

Support Offices
Regional Air Traffic Managers
Regional Air Traffic Airspace and Operations Managers
Regional Airspace Focus Leadership Teams
Facility Airspace Design Teams
ATP-1
AFS-400
ATB-1

AD-5 Links To Architecture

http://www.nas-architecture.faa.gov/CATSI.cfm?OEP_ID=AD-5

AD-6 Coordinate for Efficient Surface Movement

New tools for airport surface traffic management will provide airport personnel the capability to predict, plan, and advise surface aircraft movements. Animated airport surface displays for all vehicles on the ground will display information in real time to all parties of interest, supplementing the available visual information. Additionally, improved decision-making capability for air traffic controllers will help balance runway loads more effectively.

Key Dates

Initial Multi-Sensor Surface Surveillance Infrastructure Installed at SDF	2002
SMS Trial at MEM	2003
Deployment Decision for SMS	2004
User and Ground Vehicles Equipped	2006
Operational Surface Movement System	2007

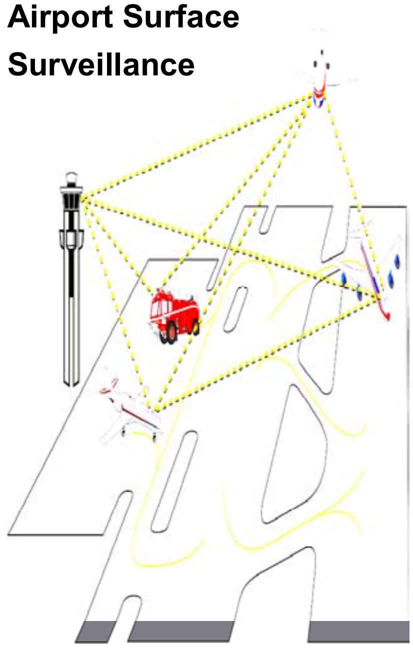
<u>AD-6 Solution Set</u>

Coordinate for Efficient Surface Movement

Improved planning, movement, and decision-making due to shared situational awareness of surface operations.

Enhanced ATC Airport Surface Surveillance

Enhanced ATC Airport Surface Application Research



Background

The airport surface remains in many respects a procedural environment since information regarding identification, position, movement, and intent of aircraft and surface vehicles is maintained solely through controller observation and verbal communication. Even at airports with surface surveillance, controllers must rely on pilots and vehicle operators for position reports to validate their mental picture and, where available, a limited situation display to make control decisions. In addition, the lack of easily accessible planning information (including information on pushback, taxi, departure, and arrivals) results in inefficiencies for flight planning and scheduling, gate management, control, and servicing of aircraft. These uncertainties in surface movement contribute not only to an inefficient use of runways and taxiways, but also result in conflicting decisions with the arrival and departure functions due to demand projections based on inaccurate surface estimates.

The goal for surface operations, as stated in the NAS Concept of Operations, is to reduce constraints on the user when airport resource (runway, taxiway, gate, etc.) demand is high. Elimination of these constraints by a migration from a strictly procedural environment to an automated, collaborative environment would minimize the overall ground delay of arrivals and departures, while incorporating user business model preferences.

Ops Change Description

The establishment and distribution of real-time surface surveillance information will increase ground efficiency. Implementation of a seamless, real-time surface surveillance capability will reduce the range of uncertainty with regard to surface movement and resource demands.

For tower air traffic controllers positive identification and accurate real time position information for aircraft and surface vehicles will result in better and timelier decision making for surface operations. Controllers will need to request fewer position reports and be able to monitor and quickly identify aircraft, for example; aircraft exiting runways after landing contacting ground control, positive identification of departing aircraft at the runway. The access to this information will allow for greater efficiency in taxiing and departure and ramp queue management since the taxi path clearance can be tailored to and monitored automatically to achieve throughput objectives. Planning and proactive control of surface traffic is made possible when controllers know the position of aircraft before initial communication/contact is made.

For both Flight Operations Centers (FOC) and Traffic Flow Management Controllers (TMC), the availability of real-time surface surveillance information will support the development and implementation of applications designed expressly to improve traffic management and projections across all phases of flight. By adding information on both the individual flight movement and aggregate flow on the surface this knowledge can be incorporated into the operational planning and decision processes over 20 minutes earlier with more accuracy, thus vastly improving the ability to project and identify periods of excess demand and other congestion. The increased accuracy will be directly reflected in more extensive Collaborative Decision Making (CDM), made possible by the more accurate, common situational awareness of not only the specific surface environment, but also the impacts across all phases of NAS operation.

Benefits, Performance and Metrics

Performance/Benefits	Metrics
Departure throughput rates will increase and average taxi-out times decrease due to better sequencing and load balancing at departure	• Aggregate sum of inter-departure spacing times should be reduced for all flights in the presence of a queue.
Improved traffic flow and increased situational awareness will decrease the taxi-times	• Taxi time from touchdown to gate for equipped flights compared to average for all flights same runway, concourse and time slot • Taxi times and departure throughput rates serve as proxies for improved traffic flow.
Airport surface safety will be improved through increased situational awareness	• Runway incursion incident rate • Taxi-Clearance deviations
Improved communications and coordination will occur between system stakeholders.	• Number of aircraft in departure queue should decline and be more evenly balanced (considering departure path and user preference). • Number, duration, and type of ATC communications within the surface area

	for a specific equipped flight during ground operations compared to average for all flights over same path (same time slot). [Communications focused on present position and intent should be reduced from the baseline.]

Scope and Applicability

Availability of a robust surveillance data fusion capability is essential to increase system efficiency, provide common situational awareness and contribute to increased safety.

- Fusion of Automatic Dependent Surveillance – Broadcast (ADS-B) and multilateration position reporting with Airport Surface Detection Equipment (ASDE) primary radar in ASDE-X: ADS-B will provide accurate downlink of GPS-based position reports for equipped aircraft. Multilateration will provide position reports for all aircraft and vehicles having tagged beacon transmitters.

- Demonstration of Multi-sensor Fusion of Surface Surveillance at Second Site (Louisville) will be conducted in September, 2002

Extension of the CDM methodology includes the provision of surface information via already established distribution architecture.

- Develop Surface Surveillance and Traffic Flow Management Data (CDM) Integration Plan in March 2002.
- Extension of information use across all service provider and user systems, as envisioned in the Concept of Operations, is dependent on establishment of standards for the exchange. Final Interface Standards for Surface Surveillance System will be published September 2002.
- By September 2002, there should be a clear definition of Surface Management System (SMS) and its interfaces. The SMS concept is planned research from the National Aeronautics and Space Administration (NASA). The goal of the SMS research is to provide tools to increase efficiency by, for example; managing departure operations, runway queuing and load balancing. A Surface Management System Trial will be conducted at Memphis in December 2003.
  - Several technologies will provide information upon which the SMS applications will be based to improve shared situational awareness and decision-making. SMS will provide decision-support tools to predict, plan, and advise surface aircraft movements and increase throughput and user flexibility using numerous data sources. SMS can provide controllers with a set of tools for tactical control and strategic planning of aircraft movements (arrivals and departures) on the surface while incorporating airline priorities.
  - Free-Flight Phase One (FFP1) SMA provides transitional capabilities that will ultimately be incorporated in SMS. SMA provides estimated landing times for flights currently in the terminal area, based on information from the local Automated Radar Terminal System (ARTS). This provides users (dispatchers, ramp controllers and other airline personnel) improved

information on arrival times to improve gate turnaround and avoid conflicts with gate management

- Independent analysis of benefits, costs and potential for use of SMS functionality across the NAS will support the business case decision for deployment. An independent Analysis of SMS Trial (to include benefits, costs, applicability to other sites) will be conducted in June 2004.
- A deployment decision for SMS will be made in December of 2004, with a target of an operational SMS in December of 2007 if a decision is made to move forward.

NOTE: Technologies that will enhance situational awareness in the cockpit, such as Cockpit Display of Traffic Information (CDTI) are discussed in AD-7.

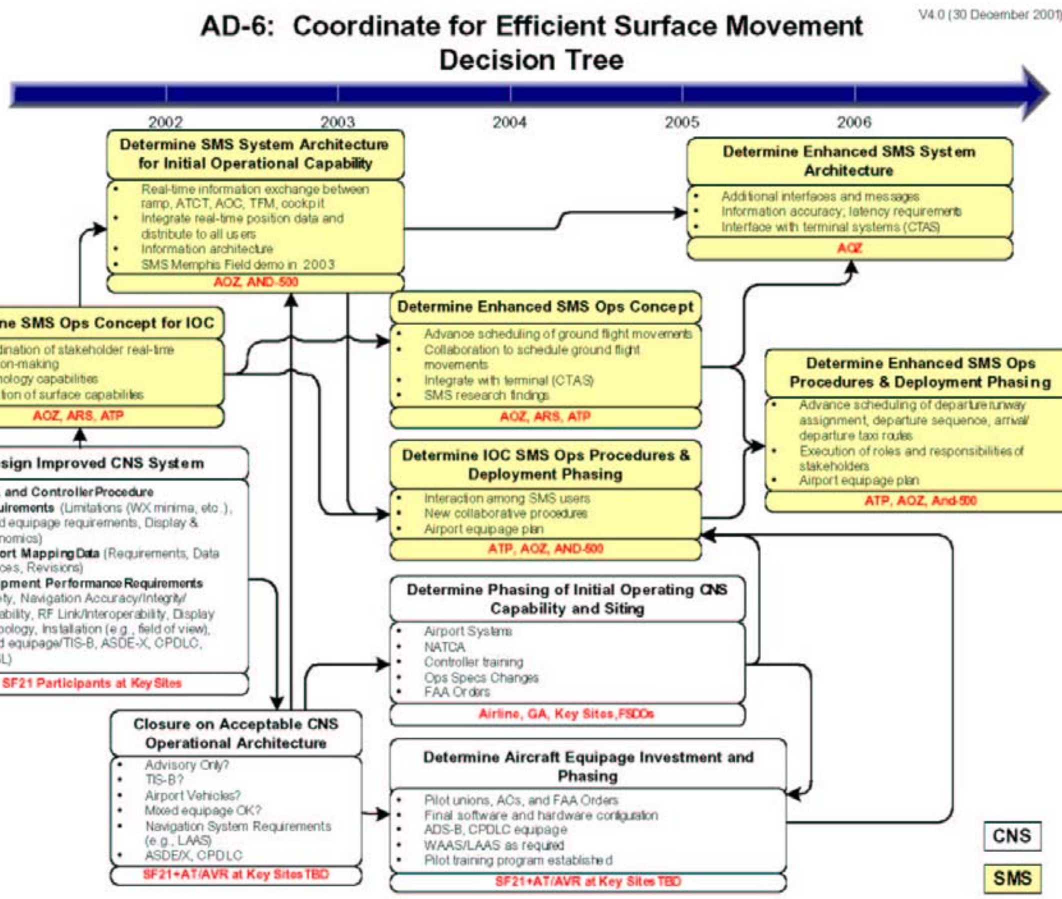
Key Decisions

- Airport equipage of enabling technologies is critical to achieving the full benefit of SMS.
- Determination after analysis in 2003 Memphis trial on need for Local Area Augmentation System for surface surveillance accuracy requirements.
- Mandatory operation of transponders on the ground.

Key Risks

- Defining a common SMS concept and requirements based on ongoing industry, FAA and NASA activities.
- Completing a NASA demonstration at Memphis in 2003.
- RTCA and international standards for surveillance data and avionics interfaces and protocols are on the critical path for scheduling.
- Deployment schedule for ASDE-X.
- Operational concept validation in Safe Flight 21.

AD-6 Decision Tree



AD-6 Responsible Team

Primary Office of Delivery
Bill Voss , ATB-1

Support Offices
AOZ-1
AND-500
SF-21 SSG
ATP-100
AIR-100

AD-6 Links To Architecture

Air Traffic Services / ATC-Separation Assurance / Surface Separation Capability
102405 - Increase Situational Awareness For Controllers By Providing Target Displays
102406 - Increase Situational Awareness For Controllers By Low-Cost Surveillance
102407 - Increase Situational Awareness For Controllers By Improving Target Displays - Demonstration
102409 - Increase Situational Awareness For Controllers By Improving Target Displays - National

Air Traffic Services / TM-Synchronization / Surface Traffic Synchronization Capability
104202 - Atlanta Surface Management Advisor
104203 - Initial Surface Management Advisor (FFP1)
104204 - Surface Management Advisor
104205 - Surface Management System - Includes Detroit and Industry Experiments

Air Traffic Services / TM-Strategic Flow / Flight Day Management
105201 - Current Flight Day Management

AD-7 Enhance Surface Situational Awareness

The Safe Flight 21 program is addressing cockpit-based tools to supplement existing visual navigation aids and controller communications in the pilot's attempts to accurately determine the aircraft's position on the airport surface. The pilot will be able to correlate fixed obstacles and traffic observed on the display with outside visual information, enhancing the pilot's confidence and efficiency in moving about the airport surface.

Key Dates

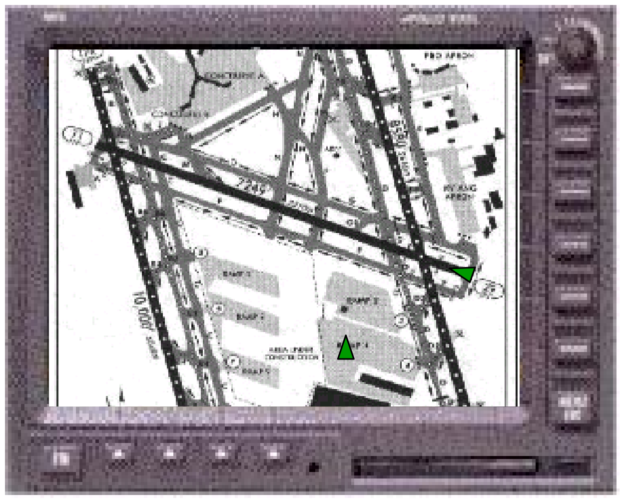
Surface Moving Map Concept of Operations	2002
Test Broadcast Services at SDF	2002
Complete Surface Opeational Safety Assesssment	2002
Certified Avionics (moving map) as Supplemental means of Navigation	2003
Deliver Airport Surface Map Database for Top 65 Airports	2003
IOC for Surface Navigation from Cockpit at Key Sites	2005

<u>AD-7 Solution Set</u>

Enhance Surface Situational Awareness

Improve surface navigation and traffic situational awareness with cockpit-based tools.

Final Approach, Runway and Taxiway Occupancy Awareness



Background

In today's environment, the pilot uses visual navigation aids and air traffic controller communications to determine aircraft position on the airport surface and uses visual references to maintain separation from aircraft and other vehicles. While the air traffic controller is responsible for separation on the runway, the pilot is responsible for separation while taxiing to the runway or gate, regardless of airport visibility. Low visibility and reduced ability to see signage can lead to confusion in navigating the aircraft on the surface. This in turn can result in the reduction of safety and efficiency through reductions in taxi times and increased fuel burn.

Cockpit simulation studies performed by NASA over a period of years, documented significant reductions in taxi times of 25% to 19% during periods of low/moderate visibility when pilots used cockpit Surface Moving Map (SMM) displays as an aid. These findings were corroborated by flight tests conducted by the Safe Flight-21 (SF-21) program at Louisville, KY, in October 2000. Future use of this capability is dependent on two key pacing events:

- First, the government, acting as an enabler, must continue to mature this technology to ensure its viability. Maturation on the government's part involves a range of activities, including development of the technology and the procedures to enable its use. A key enabler will be Broadcast Services, which will allow the pilot to view all traffic in the surface environment via an uplink of traffic data from FAA fielded Multilateration systems. At this time, through the collaborative Government/Industry partnership established in the SF-21 program, a range of developmental activities is being completed.

- Second, airlines must equip their aircraft fleets with moving map capability and have the equipment installation certified by the FAA. The cost of equipage, is typically born by the airline industry, and the level of equipage achieved will be the pacing item toward realizing the full anticipated benefits for this application.

Surface Movement Guidance and Control System (SMGCS) is required to support low visibility operations on the surface. According to Advisory Circular 120-57A, SMGCS is meant to facilitate "safe movement of aircraft and vehicles on the airport by establishing rigorous control procedures and requiring enhanced visual aids." SMGCS is tailored to each airport's specific needs and may include taxiway edge lights, taxiway centerline lights, runway guard lights, stopbar lights, taxiway/ramp marking, follow-me vehicles, training, and charting, among other initiatives. SMGCS has two categories for takeoff and landing operations: below 1,200 feet Runway Visual Range (RVR) and below 600 RVR (but not less than 300 RVR).

Ops Change Description

Air Traffic Control (ATC)

The cockpit SMM tools would now give the pilot the electronic ability to "virtually" see the same "Big Picture" view that ATC is seeing. The efficiency of ATC communications would be greatly amplified by allowing ATC to positively identify specific traffic or traffic sequences to the aircrew, which should help in the execution of taxi plans. A "Call Sign Procedure" will enable ATC to communicate the appropriate aircraft specific information.

Cockpit

Cockpit SMM tools provide crews more robust surface navigation information, increasing pilot awareness of the aircraft's position on the airport surface and other traffic operating in proximity to the aircraft. These tools help the pilot guide aircraft along the surface in accordance with ATC instructions, or in accordance with a self-generated taxi plan in the case of non-towered airports. Initially, these tools will supplement the pilot's out-the-window visual assessment of the aircraft's position on the surface, its direction, and speed. The increased knowledge of exact aircraft placement relative to the airport has been demonstrated to decrease crew workload and improve taxi performance.

In today's environment, taxi workload is normally divided between Pilot Flying (PF) and Pilot Not Flying (PNF). PF typically steers the aircraft using visual techniques. The PNF typically backs up the pilot by monitoring progressive taxi with paper maps, and handles communication with ATC. Cockpit procedural changes will allow both crewmembers to make use of the display to monitor progressive taxi, and to use the displays to positively identify specific aircraft that they may be directed to follow by ATC in a taxi sequence. Additionally, crews will need to adjust to new "Call Sign Procedures" to enable the positive identification of aircraft between ATC and the crew. This change will place the aircraft's three-letter designator onto the display.

Knowledge of proximal traffic along with call sign information is extremely useful to enable crews to correlate traffic observed on the display with outside visual information, thereby easing the process of understanding the intended sequencing when several aircraft are being formed into a queue. When crews understand the "big picture" of traffic sequencing it is expected to enable better tactical decision-making. This in turn will allow crews to take measures, such as temporary shutdown of engines to save fuel.

Benefits, Performance and Metrics

- Faster taxi times at night and under other reduced visibility conditions.
- Average and excess gate times should decrease.
- Reduced fuel burn during taxi
- As calculated in the Safe Flight-21 Cost Benefit Analysis, date 01 May 01, it is anticipated that reduced taxi times could result in approximately $3.241B in cost savings over a 20 year life cycle.

Scope and Applicability

In today's environment, ATC formulates overall taxi sequence plans, and communicates these plans as a set of instructions to both aircraft and vehicles through radio communications. The biggest challenge for ATC is making sure that the aircraft understands the communications. In executing the taxi plan, ATC uses many techniques such as identification of "company traffic" or other descriptors to ensure that pilots understand their place in the "big picture".

Moving maps should provide the same capability to receive and display the same surveillance data to tower controllers, pilots, ramp controllers, and others that are involved with surface operations. These maps are proposed for 59 ASDE-X sites.

- FAA Surface Moving Map (SMM) Enabling Activities:
  - FAA-approved Concept of Operation – March 2002
  - FAA to complete all Key Site activities at Louisville/Sandiford Airport (SDF), including Surface Operational Safety Assessment – November 2002 and the in-service evaluation and metrics collection there – Sep 2001- Sep 2005
  - Call-sign procedure limited implementation at Memphis Airport and SDF– September 2002
  - Deliver airport surface map database for top 65 airports – February 2003

- Airline Certification and Installation Plans:
  - United Parcel Service (UPS) Supplemental Type Certification (STC) for SMM in Boeing 757 – October 2002

Benefits measurements have, to date, only been simulated. It is anticipated that equipage of the UPS fleet with SMM's at their SDF Hub facility will provide the first opportunity to measure

[4] *Surface Technology Roadmap, Presentation to Runway Incursion Joint Safety Implementation Team (JSIT)*, presented by David Ford (AND-500), March 7, 2001.
[5] Automatic conflict alerts in the cockpit are not included, but the issues (human factors, training, certification) will be addressed as part of ongoing research activities.

actual performance improvements. If the bottleneck is at the departure end of the runway, increased throughput on the surface will not result in significant capacity benefits.

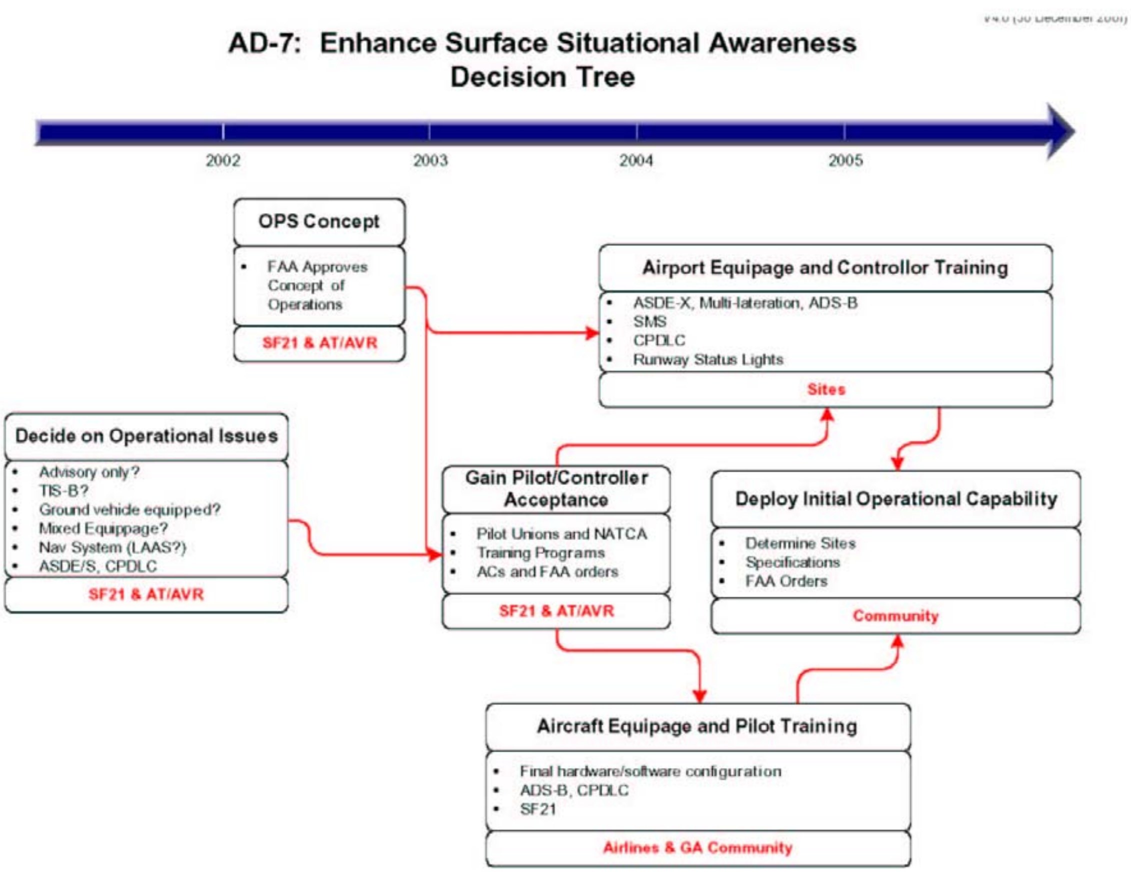
Key Decisions

- Crew coordination changes will be needed to make the most of new SMM information in the cockpit.
- Until very advanced operations are approved, the surface applications should be in support of the visual maneuvering of the aircraft and should only be used in an advisory role.
- SF-21 is currently anticipating UPS to commit to installing SMM's starting with their 757 fleet, beginning in October 2002.
- Beyond UPS, all airlines will have to commit to equipping their fleet with SMM's.

Key Risks

- Operations fall back to the current mode when position sensors (e.g., GPS-based signal) are not providing adequate accuracy or integrity (depending on the complexity of surface application) or if there is a problem with onboard avionics.
- Failure on the part of UPS airline to start equipping it's fleet with SMM's, will significantly impact our ability to implement this capability or measure anticipated benefits.
- Contingent on continued funding, SF-21 must continue maturing the technology and deliver several critical items including:
    - Resolution of cockpit human factors/workload issues (heads-down time, surface clutter, day/night visibility, and display scale, heads up/down)
    - Development of "Call Sign" Procedure for initial use at SDF
    - Development of Map Data Base for top 60 airports
    - Operational Safety Assessment to support certification
- Managing change in the acceptance of new procedures based on new technologies, from both the ATC and aircraft operators' perspectives.
- Feasibility of procedures in mixed equipage environment.
- Beyond the initial applicant, expanding use SMM to enable this application at other airports.

AD-7 Decision Tree



AD-7 Responsible Team

Primary Office of Delivery
Bill Voss , ATB-1

Support Offices
ATP-100
AND-500
SF-21 SSG
AIR-100

AD-7 Links To Architecture

Air Traffic Services / ATC-Separation Assurance / Surface Separation Capability
102408 - Increase Situational Awareness For Pilots By Providing Target Displays - National
102410 - Increased Situational Awareness For Pilots By Providing Target Displays - Demonstration
102411 - Future Surface Separation

Air Traffic Services / ATC-Advisory / Traffic Advisory Capability
103205 - Aircraft to Aircraft Increased Situational Awareness by Traffic Advisories Trials on Surface Demonstration
103206 - Enhanced Traffic Advisories Through Improved Situational Awareness